

# Atlas of Salmon and Steelhead Habitat in the Oregon Lower Columbia and Willamette Basins



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## Introduction

This atlas was developed as reference material for salmon and steelhead recovery planning in the Oregon Lower Columbia and Willamette basins. It provides a compilation and display of relevant salmon population features and habitat attributes. We provide information summarized at the scale of populations as defined by the WLC-TRT (Myers et al 2004). Maps and summary information are presented in a uniform manner for all watersheds. The atlas does not provide an explanation of how the compiled data and summary statistics should be used in recovery planning. In selecting the material to present in this atlas, we have focused on information that was both of clear relevance to salmon recovery and was relatively readily available in consistent format at this large spatial scale. The limitations of available data prevented inclusion of many types of information that would be very useful for recovery planning (e.g. detailed water quality maps or exotic species distribution maps). Even given these limitations, an initial picture of salmon habitat in the Lower Columbia and Willamette basins emerges.

## ***Acknowledgements***

We wish to thank the Willamette/Lower Columbia Technical Recovery Team for review and feedback during the development of this atlas. We would also like to thank the various state and federal agencies whose data were instrumental in producing this atlas.

## Map Descriptions

The map series described in this atlas are provided for each population in the Lower Columbia and Willamette Evolutionarily Significant Units (ESU) regions.

The following list indicates the order of the maps included for each fish population area (watershed):

- Physical Accessibility Maps
- 303(d) Maps
- ODFW Fish Distribution Maps
- FEMA Q3 Flood Maps
- Human Population Density Maps
- Land Cover Maps
- Land Use Maps
- Ownership Maps
- Riparian Condition Maps
- Water Rights Information Maps

Each of these maps is explained in greater detail in the following sections.

There are multiple species and fish populations within each watershed; separate accessibility and fish distribution maps are included for each population within a particular watershed.

Each map includes a label in the upper right-hand corner that indicates which population is represented. General information maps such as floodplains and riparian condition are provided at a map extent representative of all populations occurring in that particular watershed.<sup>1</sup>

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<sup>1</sup> Two exceptions to this are the Upper Gorge Tributaries and the Hood River, where it was necessary to include multiple land cover, land use, and ownership maps for the watershed areas to effectively reflect the scale of these features for different species.

## **Physical Accessibility Maps**

The Physical Accessibility maps include:

- Maps of physical accessibility for each salmonid population polygon.
- Table listing stream kilometers and percent total of current and historical accessibility, stream kilometers and percent total above natural barriers, total stream kilometers, and the ratio of currently accessible streams over historically accessible streams.
- Figure depicting the distribution of anthropogenic blockages by percent historical accessibility.

Spatial data describing current and historical physically accessible streams segments were produced by staff at the Northwest Fisheries Science Center for each salmonid population (Steel and Sheer 2003). These data were created using Dan Miller's NetStream (Miller 2003) as well as by referencing known barrier databases and species-specific gradient thresholds (Table 1). All area upstream of a barrier that exceeds the species-specific gradient threshold is considered inaccessible. Historical physical accessibility is based on natural barriers and gradient thresholds. Current physical accessibility is based on natural barriers, gradient thresholds, and anthropogenic barriers.

**Table 1 Gradient accessibility thresholds. The thresholds are channel gradients defined by WDFW to be impassable to salmonids (WDFW 2000).**

<b>Species</b>	<b>Gradient Accessibility Threshold</b>
Steelhead	20%
Chinook	16%
Coho	16%
Chum	5%

The physical accessibility maps include summary tables showing kilometers of streams within the salmonid population polygon that are currently or historically accessible. In addition, the total length of stream segments below a 20 percent gradient threshold (including segment above barriers blocking fish migration) is also calculated. The percent of current and historically accessible stream kilometers relative to total stream kilometers and the ratio of current to historical accessibility are also presented in the table.

The physical accessibility maps include a figure showing the distribution of anthropogenic barriers based on percent historical accessibility blocked. Each anthropogenic blockage is responsible for the loss of some percentage of historical accessibility and these percentages are displayed in decreasing order. The total kilometers lost to each blockage are also presented in the figure.

It is important to note that physical accessibility does not equate to fish presence and just because a stream is deemed accessible does not mean it is now or was ever used by a salmonid species. In presenting these data we do not mean to say that fish have or will utilize 100 percent of the accessible reaches and it is reasonable to assume that these data overestimate the stream lengths associated with current or historical distribution (see fish distribution maps).

## **303(d) Maps**

The 303(d) maps include:

- Maps of listed 303(d) streams for each salmonid population polygon.
- Small pie chart showing total 303(d) listed stream kilometers; total 1:100,000 stream kilometers within the salmonid population polygon; and the relative percentage of each.
- Large pie chart showing the relative percentage of each parameter/criterion combination present in the 303(d) map for the salmonid population polygon.

The Oregon Department of Environmental Quality (DEQ) has produced a GIS layer representing the final 2002 303(d) list approved by the United States Environmental Protection Agency (EPA) (EPA 2003; DEQ 2003). The source streams of the 1:100,000 Pacific Northwest River Reach data layer (StreamNet 2001) were originally selected from the river reach files based on the 1998 303(d) list and saved to 303(d) layers by GIS staff of Region 10 EPA and GIS staff at DEQ. The 2002 representations are updates of the 1998 layers. This layer represents water bodies with 303(d) status only. Stream segments evaluated as “attaining criteria/uses,” “insufficient data,” “potential concern,” or “TMDL approved” may be portrayed in future GIS layers.

It is important to note the limitations inherent in the methodologies associated with the 303(d) list. Because no watershed is completely censused with regard to all streams, it is incorrect to assume that water bodies not present on the censused list have qualified to pass inspection. In fact, many streams may not have been sampled, in which case those streams will not be present on the list regardless of their status. We have attempted to make it abundantly clear on the maps what proportion of the total 1:100,000 streams are listed to remind the reader of this caveat. For these same reasons, comparisons of amount or length of 303d listings between basins is not appropriate.

Each map has a set of two pie charts. The small pie chart depicts the total kilometers of 303(d) listed streams, the remaining 1:100,000 stream kilometers, and the relative percentage of each. The large pie chart shows the breakout by relative percentage of each parameter/criterion combination present in the salmonid population 303(d) map (For more information on the parameters for which a water body is listed, or on the applicable criteria for the parameter, please refer to OAR 340 Division 41). The large pie chart is color coded to a floating legend for the parameter/criterion combination. If a stream is listed under a temperature parameter and part of that same stream is also listed under an E. Coli parameter, then that one stream represents two parameter/criterion combinations (temperature only, and temperature and E. Coli) and each combination is present in both the large pie chart and the color coded legend.

Due to the difficulty associated with legibly mapping several parameter/criterion combinations, it was not plausible to map each listed stream reach as its parameter/criterion combination. Instead, for the most part, we use just the parameter field of the dataset for our primary map display. Care was taken, however, to match the color of the mapped stream reach to the large pie chart and the floating legend, where possible.

Two of the populations in the atlas (Lower Gorge Tributaries, Sandy River) do not include maps for 303(d) streams, due to either limited 303(d) information within the population boundary or lack of data visibility at the map scale used.

## **ODFW Fish Distribution Maps**

The ODFW Fish Distribution maps include:

- Maps of ODFW fish distribution for each salmonid population polygon.
- Table listing kilometers for each use type, kilometers and percent total for total use, and total 1:100,000 streams for the salmonid population polygon.

In 2004 the Oregon Department of Fish and Wildlife (ODFW) published its Oregon Salmon and Steelhead Habitat Distribution (1:100,000) GIS database. These data describe areas of suitable habitat believed to be used by fish populations. The information is based on extensive surveys, the best professional judgment of ODFW staff biologists and, where possible, the professional opinions of staff from other natural resource agencies. The data were created through a process whereby fish distribution maps were provided to ODFW and other agency field staff who then, based on survey data, supporting documentation, and professional judgment, marked the distribution of usetypes on the maps with colored pens. The first iteration of these data was completed in 1996 and since then updates have been made to all anadromous zones in Oregon. The data are updated every two years as funding allows. The database used for our maps is version 12, and was created on January 13th, 2004. All distribution data have been reviewed at least twice by ODFW field staff.

While these data represent the most comprehensive statewide compilation of anadromous fish distribution data available, it is still important to remember a few things. Some streams that are used by salmon and steelhead may not be found in the 1:100,000 scale streams data and are thus not captured by this dataset. Not all data are based on direct observations (i.e., some information is based on “undocumented professional opinion”). The historical distribution information presented should not be considered comprehensive for all anadromous zones as it was collected peripherally with current distribution information.

The ODFW fish distribution maps contain distribution information by use type (“usetype” in the ODFW metadata documentation). Use type categories are as follows:

***Spawning and Rearing:*** Defined as areas where eggs are deposited and fertilized, where gravel emergence occurs, and where at least some juvenile development occurs.

***Rearing and Migration:*** Defined as areas outside primary spawning habitats where juvenile fish take up residence during some stage of juvenile development and use the area for feeding, shelter, and growth. Some migration also occurs as juvenile and adult fish move between the ocean and spawning grounds.

***Migration:*** Defined as areas where juvenile and/or adult fish pass through as they move between the ocean and spawning and rearing areas. While all migratory corridors provide some rearing opportunities, areas with this designation are distinguished by fish moving through fairly quickly, making contributions to juvenile rearing insignificant.

***Previous/Historical:*** Historic observation of species no longer present or not detected within past five reproductive cycles.

***Present, usetype unknown or unspecified:*** Fish are present, but biologists are unsure of how habitat is being used.



***Absent:*** Known absence of species, above barriers or where access is potentially limited by environmental factors such as poor habitat and/or low stream flow. Fish must be known absent or undetected for at least five reproductive cycles. Separate datasets have been created for species absence.

***Disputed:*** Presence and/or usetype is disputed between participating biologists. See the 'Comments' field in each record for explanation.

The maps also include a table displaying the summed number of stream kilometers for each use type present in the salmonid population-specific distribution map. The table also includes the total use, or total stream kilometers summed across use types, and the total 1:100,000 stream kilometers for the population polygon.

## ***FEMA Q3 Flood Maps***

The FEMA Flood Maps include:

- Map of FEMA 100-year floodplain overlaid with land cover classifications.<sup>2</sup>
- Table listing the area of the floodplain in each land cover category, in square kilometers, and the percent in each land cover category relative to the total area of the floodplain.
- Figure depicting the spatial distribution of the floodplain, by percentage of the total floodplain calculated across 6th field Hydrologic Units.

In 1995 the Federal Emergency Management Agency (FEMA) made available its Q3 Flood Data GIS coverage at a 1:24,000 scale. The Q3 Flood Data area derived from the Flood Insurance Rate Maps (FIRMS), published by FEMA.

Our FEMA Q3 flood maps show the area inundated by 100-year flooding, within the salmonid population polygon. We overlaid the USGS land cover dataset (see land cover maps) with the 100-year floodplain to show approximately the way the land within the 100-year flood plain is being used. A numeric breakdown over land cover types including area in square kilometers and percent total is presented in the table. Also in the table is the total area in square kilometers of the 100-year floodplain within the salmonid population polygon.

Each map includes a figure attempting to display the spatial distribution of the 100-year floodplain across 6th field Hydrologic Units (HU 6). Here the HU 6s are listed on the x-axis, ordered from the lowest downstream part of the salmonid population polygon to the upper portions of the polygon, as there is 100-year flood plain present. The y-axis shows the percent total area of the floodplain in each HU 6.

It is important to note that the FEMA data were created to supply users with flood hazard information. In some cases where well-documented occurrences of dikes and levees exist, areas of historical floodplain may not be included in FEMA's representation. For this reason, some types of habitat are likely consistently under represented in the floodplain. Comparisons of historical floodplain or of land cover in the floodplain between basins are not suggested because of these biases.

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<sup>2</sup> Two of the populations in the atlas (Lower Gorge Tributaries, Sandy River) do not include maps for FEMA floodplains, due to lack of data visibility at the map scale used.

## **Human Population Density Maps**

The Human Population Density Maps include:

- Map of human population density by 6<sup>th</sup> field Hydrologic Unit.
- Table listing the year 2000 and year 2040 human population density (people/square kilometer) and the year 2000 and year 2040 total human population for the salmonid population polygon.

Year 2000 U.S. population census estimates (U.S. Bureau of the Census 2000) were used to construct our estimate of total current human population within each salmonid population polygon. This estimation uses the census blocks 2000 data layer from the Census 2000 TIGER/Line dataset. Each salmonid population polygon encompasses a large number of partial or full census blocks. To construct our estimate of year 2000 total human population we determined the proportion of each census block contained by the salmonid population polygon and attributed that proportion of the census block's population to the total human population for the polygon. We repeated this process for all census blocks that fall at least partially within the salmonid population polygon, and then summed the results to estimate the grand total.

Census Block Population within Polygon = Population of Block  $\times$  Proportion of Block within Polygon

$$\sum \text{CensusBlockPopulationwithinPolygon} = \text{TotalHumanPopulationof Polygon}$$

The Oregon Office of Economic Analysis releases county level population projections extending to the year 2040. By assigning each block in a county a weight based on its ratio of human population to the total human population for the county as a whole, we can apportion the county's growth at the scale of census block. By our method, if a block contains 10 percent of the county's 2000 population then that census block will attain 10 percent of the county's projected growth in 2040. The estimated projected growth for each census block is then added to the population estimate from the census 2000 data to predict census block population for the year 2040.

$$\text{Weight of Census Block} = \frac{\text{Population of Census Block}}{\text{Total County Population}}$$

$$\text{County's Projected Growth} = \text{2040 Projected Population} - \text{Census 2000 Population}$$

$$\text{Weight of Census Block} \times \text{County's Projected Growth} = \text{Projected Growth of Census Block}$$

$$\text{Projected Growth of Census Block} + \text{Census 2000 Population of Block} = \text{Year 2040 Population of Block}$$

By multiplying the projected year 2040 population of an individual census block by the proportion of the block contained within the salmonid population polygon, and summing for all blocks at least partially contained by the polygon, we obtained our total projected human population for the year 2040.

$$\text{Year 2040 Population of Block within Polygon} =$$

$$\text{2040 Projected Population of Block} \times \text{Proportion of Block within Polygon}$$

$$\sum \text{Year 2040 Population of Block within Polygon} = \text{Total Projected Human Population Year 2040}$$

A percent increase value was calculated to show by what percentage the census 2000 population is predicted to increase.

Current human population density estimates (people/square kilometer) were calculated for each salmonid population polygon. Population density equals the total human population of the salmonid population polygon divided by the total area of the polygon.

$$\text{Population Density} = \frac{\text{Total Human Population of Salmonid Population Polygon}}{\text{Total Area of Salmonid Population Polygon (km}^2\text{)}}$$

Prior to map production for individual salmonid population polygons the census 2000 block data were intersected with the Regional Ecosystem Office's 6th field Hydrologic Units (HU 6) and human population density estimates were calculated at the scale of the HU 6. To determine the human population density for the HU 6s a similar approach was taken as was used to construct salmonid population polygon densities. Each HU 6 contains or partially contains a certain number of census blocks. The proportion of the block contained by the HU 6 is multiplied by the block's census 2000 population and these block level "within HU 6 population estimates" were summed across the HU 6 to determine a population estimate for the HU 6. Dividing the population estimate for the HU 6 by the area of the HU 6 gives us a human population density estimate for the HU 6.

This analysis was done for all HU 6s within the study area to create a HU 6 population density layer that was used for map production. Creating this layer allows us to map all current population densities per HU 6 on an "absolute" scale, equivalent across each salmonid population map. Thus, many maps do not display any red, higher density regions, as these regions are only found in the densest places of the study area.

It is worthwhile to emphasize that our model for relating projected growth from the county level to the block level simply assumes that populations grow proportionally, that is, places where population density is the greatest will realize the greatest growth. Likely, this is not always the case

## **Land Cover Maps**

The Land Cover Maps include:

- Map of land cover for each salmonid population polygon.
- Table listing the type of land cover, area, and percent for each land class in both the watershed and historically accessible salmonid population polygons.

The land cover map is based on U.S. Geological Survey (USGS) data made available for use in a GIS in 1999 (USGS 1999). The dataset was compiled from Landsat satellite imagery taken in 1992. The latest revision of the classification key occurred in November 1998. In order to highlight relevant features and to improve visual effectiveness of the maps, we combined several of the USGS categories to produce the following classifications:

***Lakes and streams:*** Includes areas of open water, generally with less than 25 percent or greater cover of water (per pixel)

***Ice and snow:*** Includes all areas characterized by yearlong cover of ice and snow.

***Rock, sand or clay:*** Includes perennially barren areas of bedrock, desert, pavement, scarps, talus, slides, volcanic material, glacial debris, and other accumulations of earthen material.

***Sparse vegetation in transition/recovery:*** Includes areas of sparse vegetative cover (less than 25 percent) that is dynamically changing from one land cover to another, often because of land use activities. Examples include forest clear cuts, a transition phase between forest and agricultural land, the temporary clearing of vegetation, and changes due to natural causes (e.g., fire, flood, etc.).

***Grassland:*** Includes areas dominated by upland grasses and forbs. In rare cases, herbaceous cover is less than 25 percent, but exceeds the combined cover of the woody species present. These areas are not subject to intensive management, but they are often utilized for grazing.

### ***Developed:***

***Low Intensity Residential*** - areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units. Population densities will be lower than in high intensity residential areas.

***High Intensity Residential*** - heavily built up urban centers where people reside in high numbers. Examples include apartment complexes and row houses. Vegetation accounts for less than 20 percent of the cover. Constructed materials account for 80-100 percent of the cover.

***Commercial/Industrial/Transportation*** - infrastructure (e.g., roads, railroads, etc.) and all highways and all developed areas not classified as High Intensity Residential.

***Quarries/Strip Mines/Gravel Pits*** - areas of extractive mining activities with significant surface expression.

### ***Forest and Shrubs:***

***Deciduous Forest*** - areas dominated by trees where 75 percent or more of the tree species shed foliage simultaneously in response to seasonal change.

*Evergreen Forest* - areas characterized by trees where 75 percent or more of the tree species maintain their leaves all year. Canopy is never without green foliage.

*Mixed Forest* - areas dominated by trees where neither deciduous nor evergreen species represent more than 75 percent of the cover present.

*Shrubland* - areas dominated by shrubs; shrub canopy accounts for 25-100 percent of the cover. Shrub cover is generally greater than 25 percent when tree cover is less than 25 percent. Shrub cover may be less than 25 percent in cases when the cover of other life forms (e.g., herbaceous or tree) is less than 25 percent and shrub cover exceeds the cover of the other life form.

***Agriculture:***

*Orchards/Vineyards/Other* - orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.

*Pasture/Hay* - areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops.

*Row Crops* - areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.

*Small Grains* - areas used for the production of graminoid crops such as wheat, barley, oats, and rice.

*Fallow* - areas used for the production of crops that are temporarily barren or with sparse vegetative cover as a result of being tilled in a management practice that incorporates prescribed alternation between cropping and tillage.

*Urban/Recreational Grasses* - vegetation (primarily grasses) planted in developed settings for recreation, erosion control, or aesthetic purposes. Examples include parks, lawns, golf courses, airport grasses, and industrial site grasses.

***Wetlands:***

*Woody Wetlands* - areas where forest or shrubland vegetation accounts for 25-100 percent of the cover and the soil or substrate is periodically saturated or covered with water.

*Emergent Herbaceous Wetlands* - areas where perennial herbaceous vegetation accounts for 75-100 percent of the cover and where the soil or substrate is periodically saturated or covered with water.

The maps also include a table showing the square kilometers and percent total for each land cover classification in both the historically accessible portion and the watershed portion (where applicable) of the salmonid population polygon.

## **Land Use Maps**

The Land Use Maps include:

- Map of generalized zoning for each salmonid population polygon.
- Table listing type of land use (zoning class), area, and percent for each class in both the watershed and historically accessible salmonid population polygons.

The Oregon State Service Center for GIS and the Oregon Department of Land Conservation and Development are responsible for the creation and subsequent revisions of this generalized zoning for the state of Oregon GIS database. The coverage is digitized from data collected from 1983 through 1986, and the most recent revisions to the data were made in 1998. Although the information is dated, limited zoning changes have occurred since this time and the dataset is considered the best statewide zoning coverage available. The dataset represents generalized zoning data coverage, and does not show areas inside Urban Growth Boundaries. The data were digitized off 1:100,000 U.S. Geological Survey maps containing hand drawn zoning boundaries.

For mapping purposes we chose the general zoning (GENERAL\_ZO) field of the dataset for our primary display. This field includes the general zoning definition. Because of mapping limitations we did not attempt to display the specific descriptions of each zoned lot. A summary of the general zoning field and some descriptions of what each attribute may include is presented here:

**Agriculture:** agriculture and forest zones, farm and forest zones, small farm and woodlots, exclusive farm use zones, agriculture conservation zones.

**Estuary:** estuary zones, shoreline conservation zones.

**Forest:** commercial forest, exclusive forest use zones, farm and timber zones, forest and grazing, impacted forest lands, national forests, timber zones, un-zoned public lands.

**Mineral resource zone:** aggregate resource zones, mineral extraction zones, quarry and mining zones, surface mining zones.

**Conservation zone:** geothermal resource zones, lakes and wetlands zones, natural uplands zones, open space conservation zones.

**Park and recreation:** national, state, and county parks, wilderness areas, recreation zones.

**Public facility:** dump and landfill sites, community utility sites, National Guard rifle range sites, various public use zones.

**Rural commercial:** Rural commercial zones, commercial industrial zones, resorts, wrecking yards, tourist commercial sites.

**Rural industrial:** chemical and nuclear dump sites, rural industrial areas.

**Rural residential:** existing rural development, development areas, five-, ten-, and twenty-acre residential lots, ranches, mixed rural residential zones.

**Rural service center:** areas containing concentrations of local commercial services to meet the needs of rural residents and limited commercial services for tourism.

**Urban:** areas within urban growth boundaries.

**Water:** lakes and reservoirs.

The maps also include a table showing the square kilometers and percent total for each land use classification in both the historically accessible portion and the watershed portion (where applicable) of the salmonid population polygon.



## ***Ownership Maps***

The Ownership maps include:

- Maps showing land ownership for each salmonid population polygon.
- Table listing type of ownership, area, and percent for each ownership category in both the watershed and historically accessible salmonid population polygons.

In 2003 the Oregon Department of Forestry created a seamless public ownership GIS layer for the state. This layer is comprised of the best available data at a 1:24,000 scale or better. The ownership maps show the area in each salmonid population polygon under either private or public (county, state, federal) ownership. The maps also include a table showing the square kilometers and percent total for each ownership classification in both the historically accessible portion and the watershed portion (where applicable) of the salmonid population polygon.

### **Lower Columbia populations and habitat**

Big Creek  
Clackamas River  
Clatskanie River  
Upper Gorge tributary  
Lower Gorge tributary  
Hood River  
Sandy River  
Scappoose River  
Youngs Bay

### **Willamette populations and habitat**

Calapooia River  
Clackamas River  
McKenzie River  
Molalla River  
North Santiam River  
South Santiam River  
Middle Fork Willamette River

## ***Riparian Condition Maps***

The Riparian Condition maps include:

- Map of riparian condition for each salmonid population polygon
- Table listing the riparian condition classes along with the stream kilometers and percent total associated with each class.

The riparian condition maps show the “health” of vegetation within a 30-meter buffer along Steel and Sheer’s (2000) historical physically accessible stream reaches. Riparian zone condition is evaluated using a data layer that describes the proportion of streamside buffer area by vegetation class, developed following the methods of Lunetta et al. (1997).

First, vegetation information was combined to create a seamless vegetation grid for our study area. To do this we combined Interagency Vegetation Mapping Project data (data area available everywhere in study area except Willamette valley) (BLM 1991) with Pacific Northwest Ecosystem Research Consortium data (available for Willamette valley) (PNWERC 1999) to create a vegetation grid that covered our study area. Next, we intersected the vegetation data with a 30-meter buffer of the historically physically accessible stream reaches.

Functionality or impairment of riparian vegetation is based on the proportion of total buffer area in five vegetation classes: class 1, late seral vegetation, including old growth and mature second growth riparian forests; class 2, mid seral vegetation, including maturing second and third growth coniferous forests; class 3, early seral vegetation, including a mix of young coniferous and/or primarily deciduous vegetation types; class 4, ‘other forested’ lands, clear cuts, brush, young deciduous forest, and; class 5, ‘non-forested’ lands, including rock, snowfield, urban areas, agricultural land, etc. Based on field observations, each of these vegetation classes corresponds to a proportion of area in functional versus impaired condition. These observations were used to develop a functionality modifier for each vegetation class (Beamer et al. 2000). Proportion of functional riparian area is calculated from vegetation class and functionality modifiers using the following formula:

$$Rip = R_1M_1 + R_2M_2 + R_3M_3 + R_4M_4 + R_{15}M_{15}$$

Where:  $Rip$  = proportion of functional riparian area

$R_{\#}$  = proportion of total buffer area for vegetation type

$M_{\#}$  = Vegetation class functionality modifier

Vegetation Class:

1 = 1.00

2 = 0.92

3 = 0.88

4 = 0.43

15 = 0.04

Functionality and degree of impairment is determined by comparing  $Rip$  for each reach to selected threshold values for riparian condition:

Functional,  $0.81 < [Rip] \leq 1.00$

Moderately impaired,  $0.34 \leq [Rip] \leq 0.81$

Impaired,  $0.00 \leq [Rip] < 0.34$

The threshold values applied were derived from a relative ranking of riparian functions across the Lower Columbia region (see Appendix E, Chapter 4. Integrated Watershed Assessment, from the Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan (LCFRB 2004)).

## ***Water Rights Information Maps***

The Water Rights Information maps include:

- Map of location and relative size of water right for each salmonid population polygon. Color-coded 6th field Hydrologic Units displaying withdrawal totals for each unit.
- Figure showing water rights by percent total of several usage categories.
- Figure showing the cumulative percentage of the total water right allotment for just the ten largest withdrawals in the salmonid population polygon.

In 2000, the Oregon Water Resources Department finished work on its water rights GIS coverage. Individual water rights were digitized into township coverage using the best available base data for the area in question (1:24,000 or larger). Only permitted and certificated rights are digitized.

For our maps we use the points of diversion (POD) information in the water rights database. Each point on the map represents a location where surface water is diverted by the rights holder under the terms of their water rights. More than one point may appear at a given location for each water right that is served by that particular POD. It is important to note that the max rate for any POD does not necessarily represent the actual withdrawal. The max rate is the maximum withdrawal rate allowed by the water right and is reported in the GIS data layer. The actual rate of withdrawal at any POD would have to be specifically measured and is not reported in the GIS data.

The water rights maps include a graduated points system to display information on the max rate, in cubic feet per second, for each POD. The graduated point system references a floating, map-specific legend, which gives detailed information as to the max rate in cubic feet per second for the different PODs. The max rates for each POD can be summed up according to which 6<sup>th</sup> field Hydrologic Unit (HU 6) the POD resides in. The HU 6s can then be color coded according to the total max rate for the unit. This was performed for our entire study region prior to map making, so that the color-coded HU 6s are comparable across maps.

The maps also include a figure showing the cumulative percentage of the largest ten withdrawals in the salmonid population polygon (corresponding to the red dots on the map). The total max rate for the population is stated with floating text somewhere on the map. The percentage of that total owed to the largest ten withdrawals is found, one withdrawal at a time, in this figure.

The maps also include a figure showing the percent of the total max rate owed to each of several water rights usage categories. The max rate is apportioned out among the different usage categories found in the GIS data and displayed here, as percentage of the total max rate for the entire salmonid population polygon.

## References

- Beamer, E., T. Beechie, B. Perkowski and J. Klochak. 2002. Application of the Skagit Watershed Council's Strategy, River Basin Analysis of the Skagit and Samish Basins: Tools for Salmon Habitat Restoration and Protection. Working Document, prepared by the Habitat Protection and Restoration Committee of the Skagit Watershed Council, 407 Main Street, Suite 205, Mount Vernon, Washington 98273.
- BLM (Bureau of Land Management). 2001. Interagency Vegetation Mapping Project, Western Cascades (version 2.0) and Western Lowlands (version 1.0) Spatial Data, 1996. Available at: <http://www.or.blm.gov/gis/projects/vegetation>.
- DEQ (Oregon Department of Environmental Quality). 2003. Streams, Lakes and Reservoirs on Oregon's 2002 303(d) - List of Water Quality Limited Water Bodies. Oregon Department of Environmental Quality, Portland, Oregon. Available at: <http://www.deq.state.or.us/wq/303dlist/303dpage.htm>.
- EPA (Environmental Protection Agency). 2003. Oregon's Approved 2002 Section 303(d) List. EPA, March 2003
- FEMA (Federal Emergency Management Agency). 1995. Q3 Flood Data Coverage, 1:24k. Q3 Flood Data derived from Flood Insurance Rate Maps. FEMA, Map Service Center, Baltimore, Maryland 21227-5832.
- Lower Columbia Fish Recovery Board. 2004. Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan.
- Lunetta, R.S., B.L. Cosentino, D.R. Montgomery, E.M. Beamer and T.J. Beechie. 1997. GIS Based Evaluation of Salmon Habitat in the Pacific Northwest. Photogrammetric Engineering & Remote Sensing 63(10):1219-1229.
- Miller, Daniel. 2003. Programs for DEM Analysis. Earth Systems Institute.
- Myers, J., C. Busack, D. Rawding, and A. Marshall. In Press. Historical Population Structure of Willamette and Lower Columbia River Basin Pacific Salmonids. NOAA Technical Memorandum.
- ODFW (Oregon Department of Fish and Wildlife). 2004. Oregon Salmon and Steelhead Habitat Distribution. 1:100k. Fish distribution and habitat use data. Available at: <http://rainbow.dfw.state.or.us/nrimp/information/fishdistdata.htm>
- Oregon Department of Forestry. 2003. Public Land Ownership – Draft (1:24k). Oregon Department of Forestry Geospatial Enterprise Office, Salem, Oregon. Available at: <http://www.gis.state.or.us>.

- Oregon State Service Center for GIS. 1998. Oregon land zoning data. State service Center for GIS, Salem, OR. Contact: [data@sscgis.state.or.us](mailto:data@sscgis.state.or.us).
- Oregon Water Resources Department. 2001. Instream water rights themes: points of diversion and places of use. Spatial data for water withdrawals and usage for Oregon. Contact: Robert Harmon, GIS Coordinator, Oregon Water Resources Department. Available at: [http://www.wrd.state.or.us/OWRD/MAPS/index.shtml#Water\\_Right\\_Data\\_GIS\\_Themes](http://www.wrd.state.or.us/OWRD/MAPS/index.shtml#Water_Right_Data_GIS_Themes)
- PNWERC (Pacific Northwest Ecosystem Research Consortium). 1999. A combined landuse and landcover map of the Willamette River Basin for approximately 1990, version three 'a' December 15, 1999. Available at: <http://www.fsl.orst.edu/pnwerc/wrb/access.html>.
- Steel E.A., and M. Sheer. 2003. Broad-scale habitat analyses to estimate fish densities for viability criteria. Appendix I: Interim report on viability criteria for Willamette and Lower Columbia Basin Pacific salmonids. Willamette/Lower Columbia Technical Recovery Team Report. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA. Available at: [http://www.nwfsc.noaa.gov/trt/wlc\\_viabrp/appendix\\_i.pdf](http://www.nwfsc.noaa.gov/trt/wlc_viabrp/appendix_i.pdf)
- StreamNet. 2001. Pacific Northwest hydrography at a 1:100,000 scale. Pacific States Marine Fisheries Commission. <http://www.streamnet.org>
- WDFW (Washington Department of Fish and Wildlife). 2000. Fish Passage Barrier and Surface Water Diversion Screening Assessment and Prioritization Manual. Washington Department of Fish and Wildlife Habitat Program; Environmental Restoration Division; Salmonid Screening, Habitat Enhancement, and Restoration (SSHEAR) Section. Olympia, WA.
- U.S. Census Bureau (U.S. Department of Commerce). 2004. TIGER/Line Files, 2004 First Edition. U.S. Census data including census blocks and block population. U.S. Department of Commerce, US Census Bureau, Geography Division, Geographic Products Management Branch, Washington D.C. Available at: <http://www.census.gov/geo/www/tiger/>
- USGS (U.S. Geological Survey). 1999. Spatial data. Oregon land cover data set, June 1999. USGS NLCD, Sioux Falls, SD. <http://edcwww.cr.usgs.gov/programs/lccp/nationallandcover.asp>